

CHAPTER 7. WATER QUALITY

Characterization

The Gordon Creek Watershed is included in the Sandy River basin. Beneficial uses for the Sandy River basin are included in Table 286A, Oregon Administration Rules (OAR) 340-41-0286, and include:

Public domestic water supply ¹	Wildlife and hunting
Private domestic water supply ¹	Fishing
Industrial water supply	Boating
Irrigation	Water contact recreation
Livestock watering	Aesthetic quality
Fish and aquatic life ²	Hydro power

The water quality requirements to meet these uses differ. Frequently, the most sensitive beneficial use is considered when making decisions regarding designation of a water body as water quality limited. Federal law requires that the most sensitive beneficial use be protected. The underlying assumption is that if the water body meets the criteria for the most sensitive use, it will meet criteria for other uses as well. For most of the Gordon Creek Watershed, the most sensitive beneficial use is fish and aquatic life.

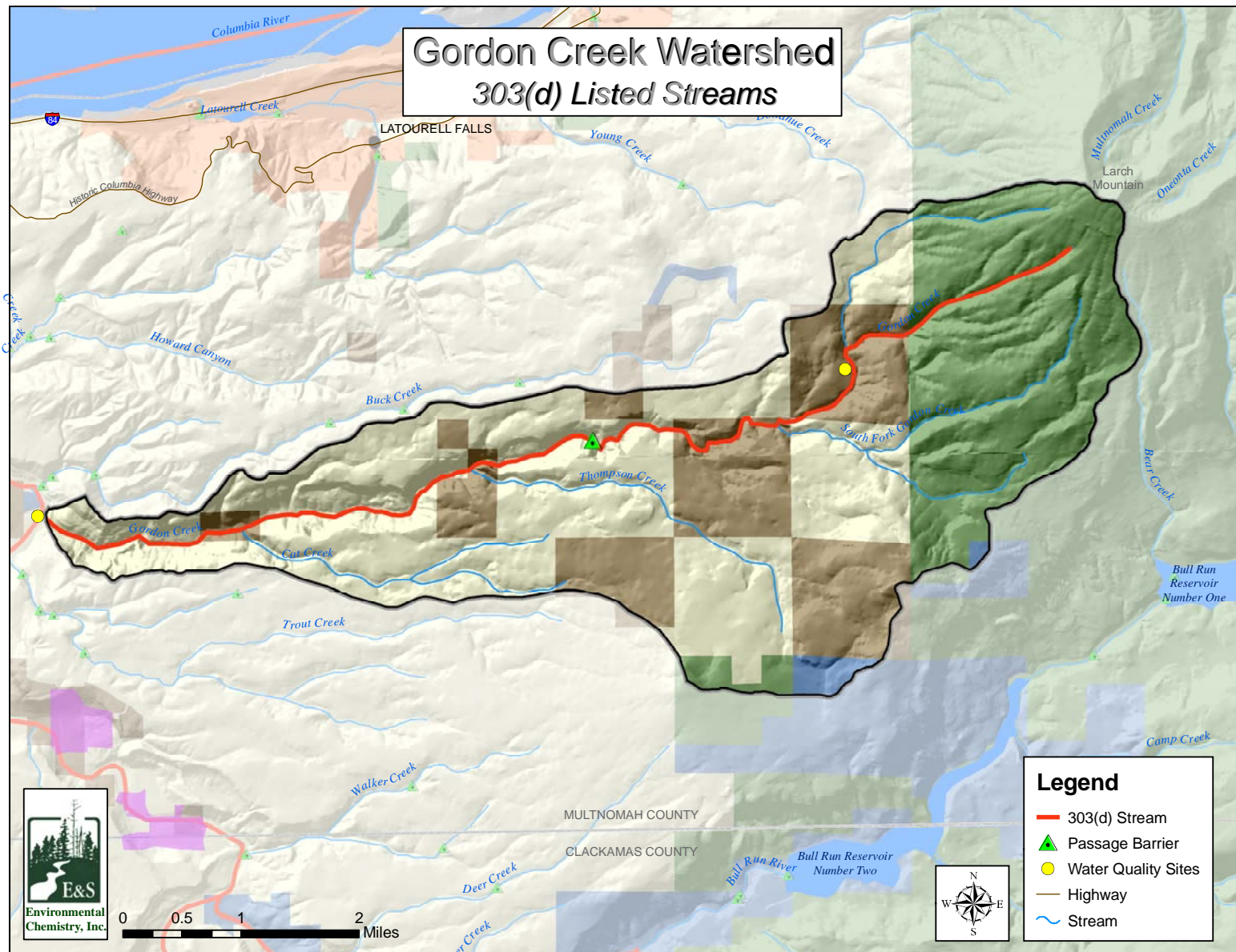
Current Conditions

Water Quality Limited Streams

If all practicable measures have been taken to improve water quality by controlling discharges and the stream still does not meet water quality standards, the water body is declared by the Oregon Department of Environmental Quality (ODEQ) to be “water quality limited” as required by the Clean Water Act section 303(d). Water bodies on the “303(d) list” must be analyzed to determine the total amount of pollutant that can be accommodated by the stream (the total maximum daily load or TMDL). The load is then allocated to all the dischargers, including non-point sources. Dischargers must then take the steps necessary to meet their allocated load. Once a TMDL and waste load allocation is completed, the water bodies to which it applies are removed from the 303(d) list. Based on data collected in 2000 and 2001, Gordon Creek from river mile (RM) 0 to RM 10.5 was designated water quality limited for temperature from September 15 through June 30, due to exceedences of the former spawning temperature criterion of 12.8°C (Map 7-1).

¹ With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards.

² Fish use designations for this basin are presented in Figure 286A and 286B, OAR 340-41-0286. The following fish use designations pertain to the Gordon Creek Watershed. Core cold water habitat—Gordon Creek and an unnamed tributary to the north from their confluence at approximately RM 8.2 upstream to the headwaters; Salmon and steelhead trout spawning use, Oct 15 to May 15—Gordon Creek from the mouth to approximately RM 7.2, Cat Creek from its confluence with Gordon Creek to the headwaters (about 1.6 miles). The remaining stream segments in the Gordon Creek Watershed are designated as salmon and trout rearing and migration use.



Map 7-1. 303(d) listed streams in the Gordon Creek Watershed.

A new temperature standard has been adopted for waters designated as salmonid spawning and rearing (13°C (55.4°F) from October 15 through May 15) since completion of the 2002 303(d) list.

ODEQ, in response to the requirements of the Clean Water Act, has completed a TMDL and Water Quality Management Plan for the Sandy River basin that incorporates and analyzes much of the data collected in the Gordon Creek Watershed (ODEQ 2005).

Water Temperature

Water temperature was recorded hourly at three locations in Gordon Creek during 2004. The results of those measurements are presented in Table 7-1 and in Figure 7-1. The data show that water temperature in Gordon Creek near the mouth exceeds the criterion for salmonid spawning, but that higher in the watershed the spawning temperature criterion is met. The temperature criterion for salmonid rearing and migration is met at all sites in the river.

Table 7-1. Summary statistics for hourly temperature data.

Site ID	31389		26385		11025	
Name	Gordon Creek at Middle Section		Gordon Creek at National Forest Boundary		Gordon Creek Near Mouth	
	°C	°F	°C	°F	°C	°F
Mean	9.3	48.7	9.0	48.2	13.4	56.1
Median	9.2	48.6	9.2	48.6	13.5	56.1
Mode	9.2	48.6	9.8	49.6	13.0	55.4
Minimum	6.5	43.7	5.8	42.4	8.6	47.5
Maximum	12.1	53.8	12.3	54.1	18.0	64.4
N	10,382		2,059		2,137	

Water Quality Constituents

Pollutant Sources

Point Sources

The Clean Water Act regulates discharge of waste to surface water. In order to discharge any waste, a facility must first obtain a permit from the state. ODEQ issues two primary types of discharge permits. Dischargers with Water Pollution Control Facility (WPCF) permits are not allowed to discharge to a water body. Most WPCF permits are issued for on-site sewage disposal systems. Industries, municipal wastewater treatment facilities, fish hatcheries, and similar facilities typically have National Pollutant Discharge Elimination System (NPDES) permits. Holders of NPDES permits are

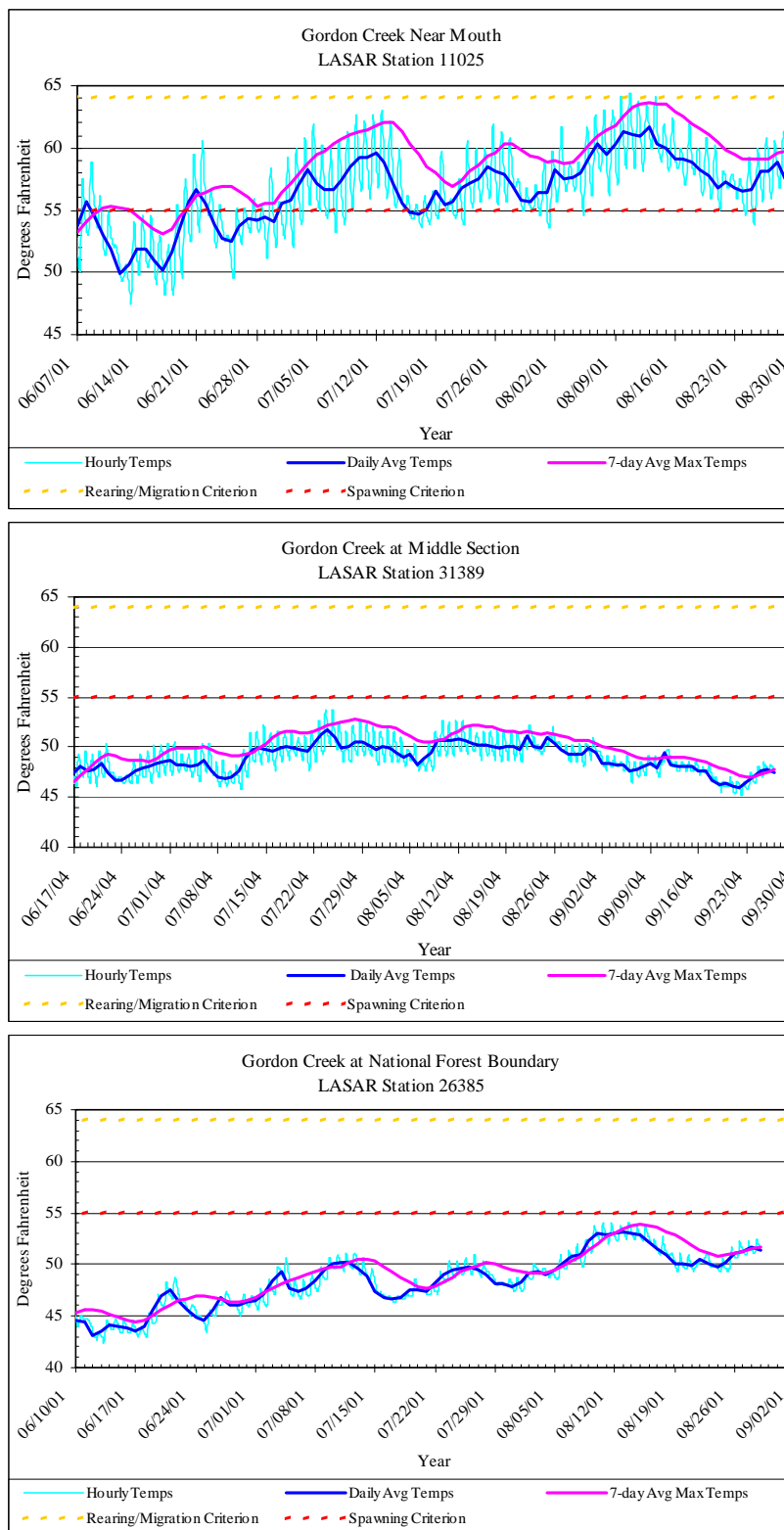


Figure 7-1. Water temperature in Gordon Creek.

allowed to discharge wastes to waters of the state, directly or indirectly, but their discharge must meet certain quality standards as specified in their permits. There are 61 NPDES and WPCF permits issued in the Sandy River basin, none of which are located in the Gordon Creek Watershed.

Non-point Sources

The largest current source of pollutants to Oregon's waters is not point sources such as factories and sewage treatment plants, but rather surface water runoff, often called "non-point source" pollution (ODEQ 2006a). Rainwater, snowmelt, and irrigation water flowing over roofs, driveways, streets, lawns, agricultural lands, construction sites, and logging operations carry more pollution, such as nutrients, bacteria, and suspended solids, than discharges from industry.

Land use can have a strong influence on the quantity and quality of water flowing from a watershed. An undisturbed watershed with natural vegetation in and along streams and rivers, and a diversity of habitats on the uplands, provides clean water that supports the desirable beneficial uses of the waterway. As the watershed is affected by logging, agriculture, or urban development, the water quality in the waterways can become degraded. The percent of land area of the Gordon Creek Watershed in various categories is shown in Table 7-2.

Table 7-2. Land cover types in the Gordon Creek Watershed.

Land Cover Type	Acres	Percent
Open Water	13	0.1
Commercial/Industrial/Transportation	2	<0.1
Bare Rock/Sand/Clay	2	<0.1
Transitional	271	2.4
Deciduous Forest	1,031	9.2
Evergreen Forest	9,192	82.4
Mixed Forest	573	5.1
Shrubland	35	0.3
Orchards/Vineyards/Other	2	<0.1
Grasslands/Herbaceous	37	0.3
Small Grains	1	<0.1
Woody Wetlands	1	<0.1
Total*	11,160	100.00

* Columns may not sum due to rounding differences

The most prominent type of land use in the Gordon Creek Watershed is forestry, with little land in developed areas. This suggests that water quality problems associated with toxic industrial chemicals may be of relatively little

concern, whereas problems associated with sediment, turbidity, temperature, and possibly bacteria are likely to be more important. To the extent that herbicides and pesticides are used in forestry operations, these compounds may assume greater importance.

Drinking Water Source Water Assessment

The Corbett Water District has water rights for 4.0 cfs on Gordon and Elk creeks. A Source Water Assessment was recently completed by the ODEQ and the Oregon Health Division to identify the surface areas and subsurface areas that supply water to Corbett Water District's public water system intake and to inventory the potential contaminant sources that may affect the water supply. The assessment was prepared under the requirements and guidelines of the federal Safe Drinking Water Act.

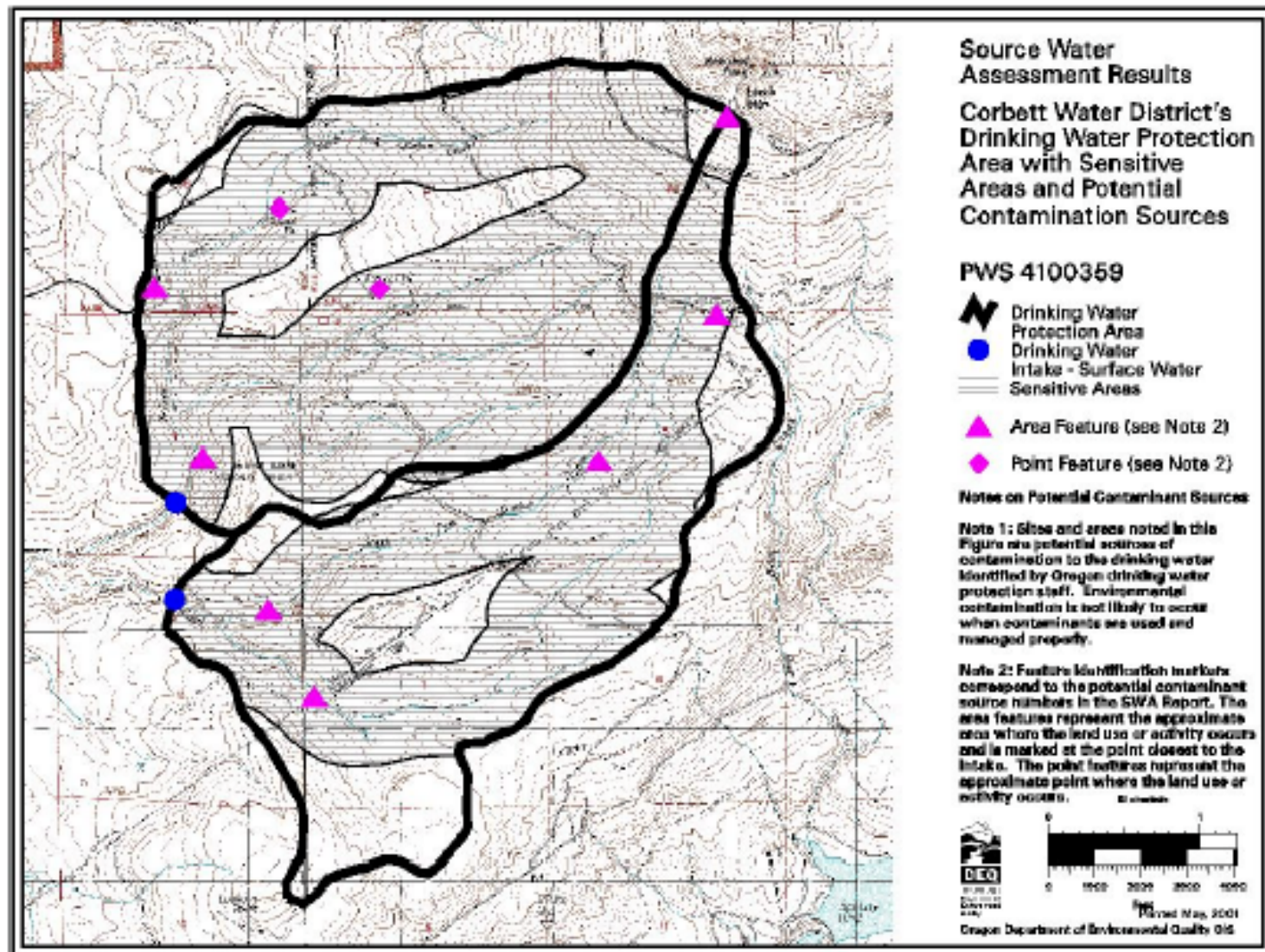
The drinking water for the Corbett Water District is supplied by two intakes located on North Fork and South Fork Gordon creeks. The water system serves approximately 2,910 citizens. The streams that contribute to the South Fork Gordon Creek and North Fork Gordon Creek intakes extend upstream a cumulative total of approximately 15 miles and encompass a total area of approximately 6 square miles. The combination of the geographic areas contributing to the South Fork and North Fork Gordon creeks intakes make up Corbett Water District's drinking water protection area. The boundaries of the drinking water protection area are illustrated in Map 7-2.

The delineated drinking water protection area is dominated by managed forest lands. "Sensitive areas" within the drinking water protection area are those where the potential contamination sources, if present, have a greater potential to affect the water supply. The sensitive areas within the Corbett Water District drinking water protection area include areas with high soil erosion potential, high runoff potential and areas within 1,000 feet of the creeks. Sensitive areas with high soil permeability were not identified in this assessment. The potential contaminant sources identified in the watershed include several regions of managed forest lands, three separate former gravel pits, an overhead power line, a public park, and Larch Mountain Road.

Nine potential contaminant sources were identified in Corbett Water District's drinking water protection area. Eight of these are located in the sensitive areas and are high- to moderate-risk sources. The identified potential contaminant sources are listed in Table 7-3.

Water Quality Data

Water quality data collected by ODEQ in the Gordon Creek Watershed were retrieved from the ODEQ LASAR database (<http://deq12.deq.state.or.us/lasar2/>). The sites for which data are available are listed in Table 7-4, and shown on Map 7-1. The data are presented in Table 7-5.



Map 7-2. Corbett Water District source water assessment map.

Table 7-3. Inventory results – List of potential contaminant sources in the Corbett Water District drinking water protection area.

Reference No. (See Figure)	Potential Contaminant Source Type	Name	Approximate Location	Proximity to Sensitive Areas	Relative Risk Level (1)	Potential Impacts	Comment
1	Managed Forest Land - Clearcut Harvest (< 35 yrs.)	Managed Forest Lands	Throughout North Fork Gordon Creek basin	Within sensitive	Higher	Cutting and yarding of trees may contribute to increased erosion, resulting in turbidity and chemical changes in drinking water supply. Over-application or improper handling of pesticides or fertilizers may impact drinking water source.	Appears to have been clearcut 15 - 30 years ago.
	Managed Forest Land - Broadcast Fertilized Areas				Moderate	Over-application or improper handling of pesticides or fertilizers may impact the drinking water source.	Appears to have been clearcut 15 - 30 years ago.
2	Random Dump	Larch Mountain	NW Region of DWPA	Within sensitive	Higher	Illegal trash and debris containing chemicals and hazardous materials may cause contamination to groundwater or surface water supply.	Heavy traffic during summer. Regular occurrence of random dumping along road.
	Transportation - Freeways/State Highways/Other Heavy Use Roads				Higher	Vehicle use increases the risk for leaks or spills of fuel & other haz. materials. Road building, maintenance & use can increase erosion/slope failure causing turbidity. Over-application or improper handling of pesticides/fertilizers may impact water.	Heavy traffic during summer. Regular occurrence of random dumping along road.
3	Mines/gravel pits No longer active	Historic Gravel Pit Wash- out	Washed out region of North Fork Gordon Creek	Within sensitive	Higher	Spills, leaks, or improper handling of chemical and wastes generated in mining operations or from heavy equipment may impact the drinking water supply.	Risk reduced to Moderate because site cleaned and closed in 1995. Washout area is ~ 10 years old.
	Random Dump				Moderate	Illegal trash and debris containing chemicals and hazardous materials may cause contamination to groundwater or impact the drinking water supply.	
	Other large washout of the area				Moderate	Impacts of this potential contaminant source will be addressed during the enhanced inventory.	
4	Random Dump	Historic Gravel Pit	North side of Lower Camp A Loop Rd., near middle of DWPA		Moderate	Illegal trash and debris containing chemicals and hazardous materials may cause contamination to groundwater or surface water supply.	
	Mines/Gravel Pits				Moderate	Spills, leaks, or improper handling of chemicals and wastes generated in mining operations or from heavy equipment may impact the drinking water supply.	

Table 7-3. Continued.

Reference No. (See Figure)	Potential Contaminant Source Type	Name	Approximate Location	Proximity to Sensitive Areas	Relative Risk Level (1)	Potential Impacts	Comment
5	Parks In-season day use only	Larch Mountain Park	Top of watershed, Larch Mtn. Summit	Outside sensitive areas.	Moderate	Over-application or improper handling of pesticides/fertilizers may impact drinking water. Excessive irrigation may cause transport of contaminants through runoff. Heavy use along edge of waterbody may contribute to erosion, causing turbidity.	No drinking or wastewater supplies within park.
	Parks In-season day use only			Just outside DWPA	Moderate	Over-application or improper handling of pesticides/fertilizers may impact drinking water. Excessive irrigation may cause transport of contaminants through runoff. Heavy use along edge of waterbody may contribute to erosion, causing turbidity.	No drinking or wastewater supplies within park.
6	Managed Forest Land - Broadcast Fertilized Areas Creek basin	Managed Forest Lands	Throughout lower region of South Fork Gordon	Within sensitive	Moderate	Over-application or improper handling of pesticides/fertilizers may impact drinking water.	
	Managed forest land -- clearcut harvest (<35 yrs)				Higher	Cutting and yarding of trees may contribute to increased erosion, resulting in turbidity and chemical changes in drinking water supply. Ore-application or improper handling of pesticides or fertilizers may impact drinking water source.	
7	Managed forest land -- broadcast fertilized areas	Managed forest lands	Through lower region of South Fork Gordon Creek basin	Within sensitive	Higher	Cutting and yarding of trees may contribute to increased erosion, resulting in turbidity and chemical changes in drinking water supply. Ore-application or improper handling of pesticides or fertilizers may impact drinking water source.	
	Transmission lines -- right-of-ways				Higher	Construction and corridor maintenance may contribute to increased erosion and turbidity in drinking water supply. Over application of improper handling of pesticides or fertilizers may impact water supply.	
8	Managed Forest Land - Broadcast Fertilized Areas	Managed Forest Lands	Throughout the upper regions of the DWPA	Within sensitive	Moderate	Over-application or improper handling of pesticides or fertilizers may impact the drinking water source.	Forest was thinned in approximately 1998 or 1999.

Table 7-3. Continued.

Reference No. (See Figure)	Potential Contaminant Source Type	Name	Approximate Location	Proximity to Sensitive Areas	Relative Risk Level (1)	Potential Impacts	Comment
	Managed Forest Land - Partial Harvest (< 10 yrs.)				Higher	Cutting and yarding of trees may contribute to increased erosion, resulting in turbidity and chemical changes (e: nitrates) in drinking water supply. Over-application or improper handling of pesticides or fertilizers may impact	Forest was thinned in approximately 1998 or 1999.
9	Mines/Gravel Pits	Historic Gravel Pit	North side of Upper Camp A Loop Rd.	Within sensitive	Moderate	Spills, leaks, or improper handling of chemicals and wastes generated in mining operations or from heavy equipment may impact the drinking water supply.	Risk reduced to Moderate because No longer active

Note: Sites and areas identified in this Table are only potential sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly.

(1) Where multiple potential contaminant sources exist at a site, the highest level of risk is used.

(2) See Table 3 for database listings (if necessary).

Table 7-4. ODEQ sample sites in the Gordon Creek Watershed.

Station ID	11025	26385	31389
Station Description	Gordon Creek Near Mouth	Gordon Creek at National Forest Boundary	Gordon Creek Near Middle
Start	5/19/1970 10:25	6/11/2004 12:30	1/1/2004 0:00
End	8/29/2001 12:00	8/29/2001 13:00	9/27/2004 15:30
N ¹	2165	2060	10406
Latitude	45.4934	45.5286	45.5105
Longitude	-122.2773	-122.1249	-122.1358
HUC Number	170800010802	170800010801	170800010801

¹ most "samples" were hourly temperature measurements

Table 7-5. Water quality data collected in the Gordon Creek Watershed, 1970 to 2004.

Station Identifier	11025	11025	11025	31389
Station Description	Gordon Creek	Gordon Creek	Gordon Creek	Gordon Creek
Latitude	45.4934	45.4934	45.4934	45.5105
Longitude	-122.277	-122.277	-122.277	-122.136
Sample Date Time	05/19/70	08/25/70	11/12/74	08/12/04
Alkalinity as Calcium Carbonate (mg/L)				14
Ammonia (mg/L)	0.1	<0.010	0.02	
Ammonia as N (mg/L)				<0.02
Biochemical Oxygen Demand (mg/L)	0.8	0.5		1
Conductivity (µmhos/cm)		50		
Chloride (mg/L)				1.3
Orthophosphate (mg/L as P)				0.01
Orthophosphate (mg/L as PO ₄)	0.02	<0.01	0.02	
Dissolved Sulfate (mg/L)				0.28
Fecal coliform (MPN/100 ml)	6	23		
Field Conductivity (µmhos/cm)				35
Field Dissolved Oxygen (mg/L)	11.7	10.5		10.5
Field pH (SU)		7.3		7.3
Field Temperature (°C)	9	14		9.8
Field Turbidity (NTU)				1
Nitrate (mg/L)	<0.050	<0.050	0.12	
Nitrate/nitrite as N (mg/L)				0.0107
Percent Saturation Field Dissolved Oxygen (%)	101	101		99
Total Coliform (CFU/100 mL)	240	130		
Total Kjeldahl Nitrogen (mg/L)				<0.2
Total Organic Carbon (mg/L)				<1
Total Phosphorus (mg/L)				0.01
Total Solids (mg/L)				31
Total Suspended Solids (mg/L)				<1

Reference Conditions

We do not have direct measurements documenting water quality in the Gordon Creek Watershed from before the beginning of large-scale timber harvest operations and road building. Variations in water quality can be inferred based on the reference conditions and ongoing processes described in the Erosion Processes, Vegetation, and Stream Channels chapters of this assessment. Intense storm events, and large fires, may have caused periods of elevated sedimentation and elevated stream temperatures.

Water Temperature

Stream temperatures were probably cooler in the past (FEMAT 1993). Nearly contiguous riparian forests shaded streams to a greater extent prior to management activities as compared with conditions today in intensively-managed watersheds.

Mature streamside vegetation probably provided considerable, though not complete, canopy cover above unmanaged streams. In general, canopy cover was more complete:

- above constrained (laterally confined) streams than unconstrained streams with floodplains.
- where the streamside stands had two or more canopy layers.
- where single-story streamside stands consisted of small mature (11 to 21 inch diameter) trees. Single-story stands of large mature (21 inch and larger diameter) trees typically had more open canopies that let more light reach the forest floor.
- higher in the watershed (1st and 2nd order streams) than lower in the watershed.

Canopy gaps next to streams that are topographically confined and have little or no floodplain are likely the result of competition with brush that prevents trees from becoming established following a severe disturbance, or senescent alders dying to leave understory shrubs that prevent tree growth (Newton and Cole 1994, Oliver and Larson 1990).

Historically, channel morphology also favored cooler water temperatures. Abundant large wood produced low gradient, depositional stream reaches with channels that were narrower, deeper, and connected to the floodplain. Greater channel complexity resulted in more and larger pools and the recharge of alluvial floodplain gravels during high flow events, followed by the gradual release of cool water during periods of low runoff. Without consumptive withdrawals, more water stayed in the streams during the summer.

In the past, ample shade, low width-to-depth ratios, and greater surface and subsurface water storage all contributed to lower temperatures.

Sediment

Natural processes have always contributed sediment to stream channels. The major mechanisms of soil erosion in the steeper portions of the analysis area include debris avalanches from drainage headwalls, shallow (three to several feet deep) debris slides, deep-seated (depths of tens of yards) slumps and earth flows, and debris flows (rapid movements of water, sediment, and wood). These delivery mechanisms can deliver a high volume of sediment, are coincident with large storm events, and occur infrequently. Lateral and vertical adjustments along larger transport and depositional stream channels also cause sedimentation. Floods and fires, though infrequent, lead to surface erosion and mass wasting.

Discussion

Most research on how forest management affects water resources is from observations of practices that were in common use in the 1960s and 1970s (Adams and Ringer 1994). These practices include sidecast road construction on unstable sites, hot broadcast burning that consumed all duff on the site, logging down to the stream edge, and removing or burning woody debris found in the streams. Technology, practices, and standards have changed since then, in no small part because of that research. In fact, aspects of federal land management under the Northwest Forest Plan (e.g. the Aquatic Conservation Strategy) are a direct outcome of that research. According to Binkley and Brown (1993), serious degradation of water quality by forest management can largely be avoided by implementation of Best Management Practices.

Water Quality Overview

Elevated stream temperatures are of concern because they can be detrimental to salmonid fish rearing and spawning, and to resident fish and aquatic life. Stream temperatures are influenced by many environmental factors including, but not limited to, direct and indirect solar radiation; watershed elevation, aspect, and topography; local, regional, and seasonal climate; precipitation amounts and timing; channel dimensions; discharge; groundwater inputs; and riparian vegetation (IMST 2004). Watershed elevation and orientation, climate, and precipitation are generally unaffected by human activity. Management activities can, however, alter shade, streamflow, and channel morphology, resulting in higher water temperatures.

Riparian vegetation can regulate stream temperatures by blocking solar radiation, the principal source of heat energy for streams (Brown 1970). Past harvest of streamside trees may have led to relatively large increases in stream temperatures, especially in smaller streams with extensive clearing. During the summer low flow period, shallow perennial streams can experience a significant temperature increase following a stand replacement event like clearcutting or a high severity fire (Brown and Krygier 1970). Surviving vegetation next to these small streams and woody debris above the channels can, however, have a moderating influence on stream temperature increases. In a study of a 237-acre clearcut watershed on the H. J. Andrews Experimental Forest, Levno and Rothacher (1967) found that logging increased the average of the July and August weekly maximum water temperatures by 4°F. Subsequent slash burning and stream cleaning in the same watershed increased the

mean monthly water temperatures by 13°F, 14°F, and 12°F during June, July, and August, respectively (Levno and Rothacher 1969).

The amount of groundwater input and the volume of summer stream flow can affect stream temperature in the Gordon Creek Watershed. Groundwater flows are slower and move through deeper soil layers than subsurface flows, which drain fairly quickly through surface soil layers (IMST 2004). This slower and deeper movement results in lower temperatures compared to surface and subsurface flows. Past harvest (nearly 54 percent of the stands on BLM-administered land are younger than 60 years old) with minimal riparian protection likely influenced stream temperatures directly (solar radiation) and indirectly. Brosnoks et al. (1997) found that streams in western Washington flowing through clearcuts became warmer even with riparian buffers. A relationship between stream temperatures and soil temperatures led the authors to suggest that subsurface flow was warmed as it moved through the heated soils of the upland clearcut.

Loss of in-channel water storage and increased width-to-depth ratio related to forest management has led to stream temperature increases. Higher gradient streams in the watershed may have lost surface and subsurface water storage capacity due to the removal of large wood necessary for the long-term detention of sediment.

Sediment

The legacy of forest management activities continues to alter the delivery and routing of coarse and fine sediment throughout the watershed. Past logging has reduced in-stream and riparian large wood associated with low-order, high-gradient source areas throughout much of western Oregon. Channels limited by storage capacity have become high-energy streams, which are incapable, in the absence of large wood, of buffering downstream reaches from sedimentation (for more information, see Chapter 8, *Species and Habitat: Aquatic*, of this assessment). Roads acting as benches and culvert constrictions have intercepted landslide debris and bedload, limiting the recruitment of these materials to depositional stream reaches. Some low-gradient reaches channelized by road construction and affected by wood removal or splash damming export substrate at an unnatural rate and continue to store less material, especially smaller diameter substrates, than in the past.

Water Temperature

Temperature at ODEQ site 11025 near the mouth of Gordon Creek exceeds the evaluation criteria for salmonid spawning and incubation, as reflected in the inclusion of Gordon Creek on the 303(d) list for temperature.

Other Constituents

The evaluation criteria for this watershed analysis are based on the Oregon Water Quality Standards (OAR 340-041-0001 to 340-041-0350) and on literature values where there are no applicable standards, as for example, for nutrients (WPN 1999, EPA 2001). The evaluation criteria are not identical to the water quality standards in that not all seasonal variations are included. The evaluation criteria are used as indicators that a possible problem may exist. The criteria are listed in Table 7-6.

No measured constituent other than temperature exceeds the relevant evaluation criterion. Water quality data are insufficient, because there are measurements for only one or two days at two sites. The impairment condition of Gordon Creek is thus unknown. Given the relatively undeveloped nature of the watershed, it is reasonable to expect that water quality would be unimpaired for most constituents. The exceptions are those constituents that might be influenced by forest management practices such as temperature, turbidity, and suspended solids.

Water Quality Trends

The ODEQ has completed the Sandy River TMDL assessment to address water bodies not meeting water quality standards in the Sandy River basin. The water quality parameters addressed are bacteria, temperature, and dissolved oxygen. The TMDL includes development of a monitoring and review plan to determine trends.

Although the 303(d) list identifies water bodies that are known not to meet current water quality standards, the list is not necessarily a complete indicator of water quality in a particular basin. For many stream segments there are not enough data to make a determination. In addition, the 303(d) listing is tied to the total amount of monitoring done, which is influenced by the number of special monitoring studies completed by ODEQ. Because special studies are frequently concentrated where water quality degradation is a concern, the list is weighted toward poorer quality waters. Consequently, the ODEQ has developed the Oregon Water Quality Index (OWQI) as a water quality benchmark that is keyed to indicator sites monitored regularly by ODEQ.

The OWQI is a single number that expresses water quality by integrating measurements of nine water quality variables (temperature, dissolved oxygen, biochemical oxygen demand, pH, ammonia, nitrate-nitrogen, total phosphorus, total solids, and fecal coliform bacteria). Its purpose is to provide a simple and concise method for expressing the ambient water quality of Oregon's streams. The OWQI values range from 10 (worst case) to 100 (ideal) (ODEQ 2006).

ODEQ monitors the Sandy River at Troutdale Bridge (RM 3.1), which is approximately 9.5 river miles downstream of the Gordon Creek Watershed. Water quality at this site is occasionally affected by moderately high levels of total phosphates and biochemical oxygen demand during high flows. This indicates the introduction of inorganic and organic materials to the water by runoff from fields, ditches, and storm drains. Moderately high temperatures during summer low-flow periods have been noted. On average, OWQI scores for the Sandy River are excellent (91-93) throughout the year.

Table 7-6. Water quality criteria and evaluation indicators. Source: WPN 1999, EPA 2001

Water Quality Attribute	Evaluation Criteria
Temperature	<p>Core cold water habitat: The seven-day-average maximum temperature may not exceed 16.0 degrees Celsius (60.8 degrees Fahrenheit).</p> <p>Salmon and steelhead trout spawning: may not exceed 13.0 degrees Celsius (55.4 degrees Fahrenheit) from October 15 through May 15.</p> <p>Salmon and trout rearing and migration: may not exceed 18.0 degrees Celsius (64.4 degrees Fahrenheit).</p>
Dissolved Oxygen	<p>For active spawning areas from October 15 through May 15: the dissolved oxygen may not be less than 11.0 mg/L. However, if the minimum intergravel dissolved oxygen, measured as a spatial median, is 8.0 mg/L or greater, then the DO criterion is 9.0 mg/L.</p> <p>Cold-water aquatic life: the dissolved oxygen may not be less than 8.0 mg/L as an absolute minimum. Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 8.0 mg/L, dissolved oxygen may not be less than 90 percent of saturation.</p>
pH	Estuarine and fresh waters: 6.5-8.5.
Nutrients	<p>Total phosphorus, 0.022 mg/L</p> <p>Total nitrate, 0.38 mg/L</p>
Bacteria	<p>(A) A 30-day log mean of 126 <i>E. coli</i> organisms per 100 milliliters, based on a minimum of five (5) samples;</p> <p>(B) No single sample may exceed 406 <i>E. coli</i> organisms per 100 milliliters.</p>
Turbidity	2.34 NTU, 50 NTU maximum
Organic Contaminants	Any detectable amount
Metal Contaminants	<p>Arsenic, 0.190 mg/L</p> <p>Cadmium, 0.0004 mg/L</p> <p>Chromium (hex), 0.011 mg/L</p> <p>Copper, 0.0036 mg/L</p> <p>Lead, 0.0005 mg/L</p> <p>Mercury, 0.000012 mg/L</p> <p>Zinc, 0.0327 mg/L</p>